A REVIEW OF ACHARYA SUSHRUTA’S APPROACH IN DISSECTION FOR THE STUDY OF NETRA SHAREERAM

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ABSTRACT

Recent literature suggests that the dissected cadaver remains the most powerful means of delivering fundamental regional, relational and topographical anatomical knowledge to medical students, which is indispensable to ensure safe and efficient clinical practice. Acharya Sushruta is best known for his surgical wisdom, practices and tools. He described a systematic method for the dissection of the human cadaver. Netra is one of the most briefly described anatomical structure by Sushruta. Anatomically, eye is divided into five Mandalas, six Sandhis and six Patalas. Selection of appropriate cadaver was very necessary for the detailed study of human anatomy; hence Acharya Sushruta had described various conditions for the selection and preservation of the cadaver. In this paper the potentially possible scientific reason for such selection criteria, as well as an attempt to understand the anatomy of eye in prospect to the ancient text by our acharyas is made. In addition, an approach is made to study importance of eyes with respect to knowledge about Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishta Suchaka Lakshana in patient, to know the Sadhyaasadhyyata of a Vyadhi, & to decide the Sara of a person.
Keywords: Shavavicchedana, Netra Shareer, Mandala, Patala, Sandhi, Dirghayu, Madhyamayu, Heenayu, ArishtasuchakaLakshana, SadhyaAsadhyata, Sara

INTRODUCTION

Human cadaveric dissection has been used as the core teaching tool in anatomy for centuries. The introduction of systemic human cadaveric dissection is a remarkable moment in the history of science. Two sets of texts form the foundation of Ayurvedic medicine, the Sushrutasamhita and the Charakasamhita. The Sushrutasamhita gives knowledge about important surgical and anatomical information of human anatomy. AcharyaSushruta is best known for his surgical wisdom, practices and tools. He described a systematic method for the dissection of the human cadaver. In 5th chapter of Sharirasthana in Sushrutasamhita, importance of Shavavichedana(dissection), method of selection of dead body, method of preservation of dead body is described.  

Importance of Shavavichedana- Susruta Samhita mentions the role of a student in the dissection: A pupil, otherwise well-read, but uninitiated, in the practice (of medicine or surgery) is not competent to take in hand the medical and surgical treatment of disease. Therefore one who intends to acquire definite knowledge of surgery should study the anatomy practically by dissecting the dead body properly. Whatever is practically seen and whatever is known from scriptures both combined develops the knowledge further. According to Acharya Charak, knowledge of Sukshma and Sthulashareer is very necessary for Shareer-Rachna. Even so, recent literature suggests that the dissected cadaver remains the most powerful means of delivering fundamental regional, relational and topographical anatomical knowledge to medical students, which is indispensable to ensure safe and efficient clinical practice. Evidence suggests that learning anatomy by active exploration through cadaveric dissection actually contributes to improvement of anatomic knowledge. There is also compelling evidence suggesting that the knowledge of human anatomy was revealed by both inspection of the surface of the human body and through human dissection, as he believed that students aspiring to be surgeons should acquire a good knowledge of the structure of the human body.

Selection of Cadaver-A cadaver should be selected which has all the parts of the body present, of a person who had died due to poisoning, but not suffered from a chronic disease, had not attained a 100 years of age and from which the fecal contents of the intestines have been removed. The probable reason of such selection criteria must be because all the above conditions can hinder with the observations made from the study. It is important to have all the parts of body to cover each organ for the study. Various poisons cause ocular effect which can alter the anatomical points of the eye and affect the study. For example, Carbon monoxide can cause retinal haemorrhage, venous tortoosity, engorgement and papilloedema. Pesticide exposure has been associated with retinopathy in agricultural workers & abnormal ocular movements. Saku disease, an optic autonomic peripheral neuropathy has been described in people living in area where organophosphates are used. There may be drug induced ocular toxicity such as systemic cytarabine can cause keratitis, corneal opacity, corneal oedema. Opium, Carbolic acid & Chloral hydrate causes pupil constriction. Dhaturola, Belladona & Chloroform dilates the pupil. In kalpastrhana of Sushrutha Samhita, he has described ocular features in certain poisoning, such as vapours coming from poisonous food causes Vibhranta Netrata, Amashayagata & Pakwashayagata Visha causes Indriya Vikrata, Savishaanjana when applied can cause Ashru, Upadeha, Daha, Drishtivibhrama & even Andhyatva. Poisoning from Vatsanabh & Kadarma causes Peetanetrata, that from Pundarika can cause Rakta Netrata. Just like this, many chronic systemic or ocular diseases can enhance ocular damages. Retinopathy or maculopathy caused by Hypertension, collagen vascular disorders, Giant cell arteritis causes ocular damage. Nephritis can cause cataract, background retinopathy, neovascularisation, ocular motor nerve palsy, papillary
anomalies & refractive errors. The effect of systemic
disease and toxin can also be understood by this that
according to Acharya Dalhana, Uttarantranta which
contain major part of Shalakyanatyana, is started after
dalhan that deals with toxicology. So, the poison
or infected wound can produce complication any-
where in the body. He may be of the view that most of
the disease of eye, ear etc., are the complication of
systemic disease and toxins. Acharya dalhan has also
said “Sarveendriyanaam madhye nayanasya pra-
dhantvata” i.e. eye is present in between all Indriya
and is prime so foremost anatomy of eye has been de-
scribed in detailed. Age of the cadaver should not be
more than 100 years as degeneration of organ starts at
elderly age like changes in skin, fall down of teeth,
bones become weak, muscles get shrink, and liga-
ments get flaccid which causes problem in studying
the parts. Intestine should be emptied- because many
bacteria are present in there that causes early decom-
position, also after cleaning the intestine it will be
prepared as a specimen for the study.

Preservation of cadaver- Such a cadaver, whose all
parts are wrapped by any one of “Munjia” (bush or
grass), Valkal, “Kusha” and Shana and kept inside a
cage, should be put in a slowly flowing river and al-
lowed to decompose in an unlighted area for seven
days. Stagnant water is home for many microorgan-
isms which can damage the body, that’s why it should
be kept in slowly flowing river and the water keeps
the skin moist and free from odour. To protect from
other animals & prevent the body from drowning,
it was kept in a cage. Wrapping the body with Munjia,
Valkala, Kusha and Shana protects the body from an-
imals. Valkala has properties like Antiseptic, Anti-
inflammatory, Antioxidant, Antibacterial, Antimicro-
bial, Wound purifying & Healing and Astringent¹⁵,
also in Ayurveda Panchavalakala is said to has
Shothahara & Vranopaka property. Kusha has anti-
bacterial¹⁶, astringent, antiseptic & toning proper-
ty”Shana is a source of natural fibre¹⁸, Astringent¹⁹,
Antimicrobial activity²⁰ All this method kept the ca-
daver safe from harm, destruction or decomposition.

Netra Shareer Rachna in Sushruta Samhita-
The only authentic source of Shalakya Tantra
knowledge is Uttarantranta of Sushruta Samhita which
has been written as per teachings of Acharya Nimi.
Acharya Sushruta has given prime importance to
Netra and described in detailed about the various ana-
tomical content in term of their embryology, situation,
size, shape & relation.

**Position-** Head is the supreme part of the human
body, when compared to all other parts. It is the site
for life for living beings. All the senses and their organs
are situated in and supported by the head.²¹

**Shape -** In SushrutaSamhita Uttarantranta, Acharya has
described Netra as Suvrittam, Gostanakaram and Na-
yana Budbudam, which denotes the shape and con-
sistency of the Netra.²²

- **Suvrittam:** By the word Suvrittam means, that eye
  is spherical from all sides.
- **Gostanakaram:** eye is shaped like that teat of the
cow i.e. oblong shaped or oval shaped. Eyeball
seen along with extra-ocular muscles and optic
nerve is very much similar to Cow’s teat.
- **Nayana Budbudam:** It is round in shape and soft
  in consistency and glistening in character, this
term is suggestive of external appearance of the
eye in the eye orbit

**Dimensions of netra²³** - The measurements of the
eyeball were described by Sushruta in terms of Angu-
li, like any other organ but, Anguli in context to meas-
urement of Netra is equal to Swangushthodara- one’s
own thumb in the words of Sushruta, which has been
supported and clearly written by the commentator
Dalhana. While describing the dimensions of eye,
Sushruta had given two dimensions – 2 Angulas Ba-
hulya and 2 ½ Angulas Sarvatah. According to
Dalhana and some scholars, the word Bahulya means
antero-posterior diameter or thickness of the eyeball
and it is 2 Angulas. As per their view, the word Sar-
vatah can be considered as the side-to-side measure-
ment i.e. circumference of the eyeball; and it is 2 ½
Angulas. But the exact measurement of 2 ½ Angulas is
better applicable to the side to side distance of the eye,
i.e. the distance from inner canthus to outer canthus.
There is some different interpretation for the word,
Dvyangulam Sardham. According to Dalhana, the word DvyangulamSardhama means Ardhatriteeyangula. This was commented by some scholars as 3 ½ Angula, and they apply it as the circumference of the eyeball.

Anatomical parts of the netra: The anatomical parts of the eye were described by Sushruta as five Mandalas, six Sandhis and six Patalas.

Table 1: Mandala- The consecutive circular layers of the eyes are termed as Mandalas.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name</th>
<th>Probable structure of eye according to modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pakshma Mandala</td>
<td>Eye lashes when eyes are open</td>
</tr>
<tr>
<td>2</td>
<td>Vartma Mandala</td>
<td>Eye lids when eyes are closed</td>
</tr>
<tr>
<td>3</td>
<td>Shukla Mandala</td>
<td>Sclera covered with conjunctiva</td>
</tr>
<tr>
<td>4</td>
<td>Krishna Mandala</td>
<td>Cornea and Iris</td>
</tr>
<tr>
<td>5</td>
<td>Drishti Mandala</td>
<td>Central part of cornea/Lens cortex/Pupil/visual axis</td>
</tr>
</tbody>
</table>

Table 2: Sandhi-Sandhis are the Junctional Areas’ between two Mandalas

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of the Sandhi</th>
<th>Probable structure of eye according to modern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pakshma – Vartmagata</td>
<td>Eye lid margin</td>
</tr>
<tr>
<td>2</td>
<td>Vartma – Shukla gata</td>
<td>Fornices</td>
</tr>
<tr>
<td>3</td>
<td>Shukla – Krishna gata</td>
<td>Limbus/ Corneo-Scleral junction</td>
</tr>
<tr>
<td>4</td>
<td>Krishna - Drishti gata</td>
<td>Pupillary margin</td>
</tr>
<tr>
<td>5</td>
<td>Kaneeanka Sandhi</td>
<td>Medial canthus</td>
</tr>
<tr>
<td>6</td>
<td>Apanga Sandhi</td>
<td>Lateral canthus</td>
</tr>
</tbody>
</table>

Table 3: Patalas- Which means a layer, veil, covering chest, membrane especially of the eyes, a film over the eyes. There are 6 Patalas in the eyeball – 2 Vartma Patalas (Upper and Lower) and 4 Akshi Patalas (Layers in the eyeball)

<table>
<thead>
<tr>
<th>Name</th>
<th>Anatomical Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahya1stPatala</td>
<td>Sclera &amp; Cornea</td>
</tr>
<tr>
<td>2ndPatala</td>
<td>Uveal Tract</td>
</tr>
<tr>
<td>3rdPatala</td>
<td>Lens Cortex with peripheral Retina</td>
</tr>
<tr>
<td>Last4thPatala</td>
<td>Lens Nucleus with Central Retina</td>
</tr>
</tbody>
</table>

Other references of eye anatomy in Sushruta-
Sushruta has used Vartma Mandala and Vartma-Patala to suggest eyelids. Vartma Mandala refers to both eyelids when closed whereas VartmaPatala refers to upper & lower eyelid. Vartma Mandal Tarunasthi in Sushruta suggest the tarsal plate where as Vartma Sandhini suggests as inner and another canthus. The term ‘Netrakosha’ is used by Sushruta in Tarpan Kriya chapter. While describing sites of oblique incision Sushruta used the term ‘AkshiPuta’ where as Dalhana refers as Akshivartma. Charaka used the term as ‘AkshiVartma’ in Pratyanga Shareer. The term Vartma Kosha is coined in Sushrutha Uttartantra to describe inflammatory conditions of eyelid. This implies palpebral part of conjunctiva. Vartma-Shukla Sandhi refers to the junctions of palpebral and bulbar conjunctiva. Shuklatachara, Tejojalashrita Bahya Patala - These terms refer to cornea as it is described during surgical procedure of Linganasha (cataract). The description of Savrana Shukla, Avrana Shukla and Akshki-Pakatyaya refers to corneal injuries. Hence ‘Shukla taraka’ term was used to denote cornea. Nimeshini and Unmeshini Sira- Sushruta and Dalhana refer to a disease Vartma Nimesha in which a symptom of winking of eyes is evident. Both explain that this phenomenon occurs due to defect in Un-
meshini and Nimeshini Sira. This disease is also described in modern ophthalmology as blepharospasm. It is said to be caused by spasm of muscles due to stimulation of ocular branch of facial nerve and ocular motor nerve. As facial nerve (ocular branch) regulates closing of eyelids, we can correlate it with Nimeshini Sira, and ocular motor nerve regulates opening of eyelid we can correlate with Unmeshini Sira.

**DISCUSSION**

While talking about Drishti Acharya Sushruta has described the Drishti to be the size of Masuradala, prasada of Pancha-Mahabhootas, gleaming like a glow worm or covered by the external patala of the eye and appearing like a hole having a natural tolerance to cold. Sushruta has given the measurement of Drishti as 1/7th of Krishna Mandala in Uttarantra. But in Sutrasthan, it is described as 1/9th of Taraka. Here the meaning of Taraka was given as Krishna Mandala. So different measurements for the same structure given by the same author points that Drishti is a constricting and dilating structure and this also points to the pupil. So, 1/7th of Krishna Mandala is probably the measurement when the iris is dilated, while 1/9th of Krishna Mandala is the measurement when the iris is constricted. Going through the description, we can see that Sushruta has dealt with Patala in brief but without mentioning their exact anatomical position in the eye. Moreover, the concept of Patala in context to Savaranashukla, can be taken as three layers of cornea, i.e. Epithelium, Stroma & Descemet membrane including endothelium. Whereas, in context to Nayanabhigata, Patalas can be taken as the three tunics of the eyeball. While describing Timira, Kaanch, Nilika, & Linganashasha Sushruta & Vagbhata have classified its stages in relation to its involving different Patalas of Drishti Mandala. The outer fibrous coat, i.e. cornea & sclera which gives shape, size & protection to the eyeball is the first Patala. Axial length & curvature as causes of refractive errors are due to the anomalies in this coat of eyeball. Second Patala can be considered as the uveal tract. Uveal tract has most sensitive tissues & develop an inflammatory response following innumerable exogenous causes resulting into fall of vision. This causes vitreous opacity resulting into floaters in front of eyes. All these are the clinical feature of second Patala pathology described by Sushruta. Clinical feature of third Patala are very much similar to the corticular part of opacity of the lens. Fourth Patala is inner most & constituted by Asthi, the hard tissue. With advancement of cataract nearly complete loss of vision is there, where in pupillary colour change to dense grey, which are similar to feature of fourth Patalagata Timira. After reading the description on eye anatomy by Sushruta it is clear that he had first observed the structure from outside and wrote the details what he saw from observing. While writing about Mandalas he said “Anupurvarantu Temadhyya Chatvaroantyauttutaram”, i.e. from going outside to inside Pakshma is followed by Varta, Vartma is followed by Shukla, Shukla is followed by Krishna & Krishna is followed by Drishti Mandala. While coming from inside to outside this sequence is reversed it goes from medial to more lateral. This was observed before dissecting the eyes. While discussing about the dimension of eye Acharya Sushruta has taken out eye along with the extraocular muscles and optic nerve that is why it resembled Gostanakaram. Alonge with anatomy of eye Sushruta has also told about its relations to structures like Sira, Kandara, Meda, Kalaka, Sleshma, that holds the eye in position. The Panchamahabhuta composition of eye given by Sushruta also proves that he has dissected the eye very keenly and came to know about the blood supply, muscular part & lacrimal apparatus associated with the eye. Also, while describing Puvalasa (Dacryocystisis) Acharya Sushruta and Dalhana both have described Ashru Marga and Netra Nadi. It means that lacrimal apparatus was known to both Acharyas. The term Ashru Vahini was also coined by Sushruta for the lacrimal apparatus. The different size of Drishti suggests that he has observed the eye in living human being. Also, the description of Drishti which include features like Masuradala, Khadyotvisphullingabham is also observed on a living body. The study of Patala can be said that it was done on a cadaver as the Patala are divided into Bahya and Abhyantar bhaga. In Ayurveda, the eyes were not only
important for its anatomical aspects but also to know about Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishtasuchakalakshana in patient, to know the Sadhyaasadhyaata of a Vyadhi, & to decide the Sara of a person. Acharya Charak in Indriyasthana, gave many Arishtasuchakalakshanas related to eyes to predict the death of a person for example, a person whose eyelashes are stick together without any reason, lid oedema,& unable to close his eyes or if there is sudden loss of vision, all these are Arishtasuchaka lakshanas. A person who sees sky as a condensed matter and earth as nothing or a space & who sees a fire in various color will die in 7 days. While discussing about features of Asadhyavyadhi, Acharya Charak has mentioned feature like Indriyanasha i.e. loss of senses including vision In Sushruta Samhita Sutrasthan, a person with Dirghayu will have Shhira indriya, Madhyamayu will have few lines below the eyes, & Hinayu will have Vibhranta netrata. In above Chapter only, he has described Shareerpamana, the distance between two eyes is said to be 4 Angulas & distance between ear & outer canthus is 5 Angulas. While describing about various features of Sara, Shukra Sara Purusha will have Shwetanetra, Majjasara Purusha will have Mahanetra & Raktasara Purusha will have Snidha Netra.

CONCLUSION
In this paper the potentially possible scientific reason for such selection criteria, as well as an attempt to understand the anatomy of eye in prospect to the ancient text by our Acharyas is made. In addition, an approach is made to study importance of eyes with respect to acquainstain about Dirghayu, Madhyamayu & Heenayu of a person, to know about the Arishtasuchakalakshana in patient, to know the Sadhyaasadhyaata of a Vyadhi, & to decide the Sara of a person. Further review of our Ayurvedic literature should be done to understand the Netra as a whole entity.

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